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EERC Technology… Putting Research into Practice

The Plains CO_2 Reduction (PCOR) Partnership

John Harju

The Montana Symposium: Energy Future of the West

Bozeman, Montana
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PCO2R Partnership

NETL NATIONAL ENERGY TECHNOLOGY LABORATORY

PCOR Partnership

1.36 million square miles
9 States and 3 Canadian Provinces
619 million tons of CO_2 emissions annually

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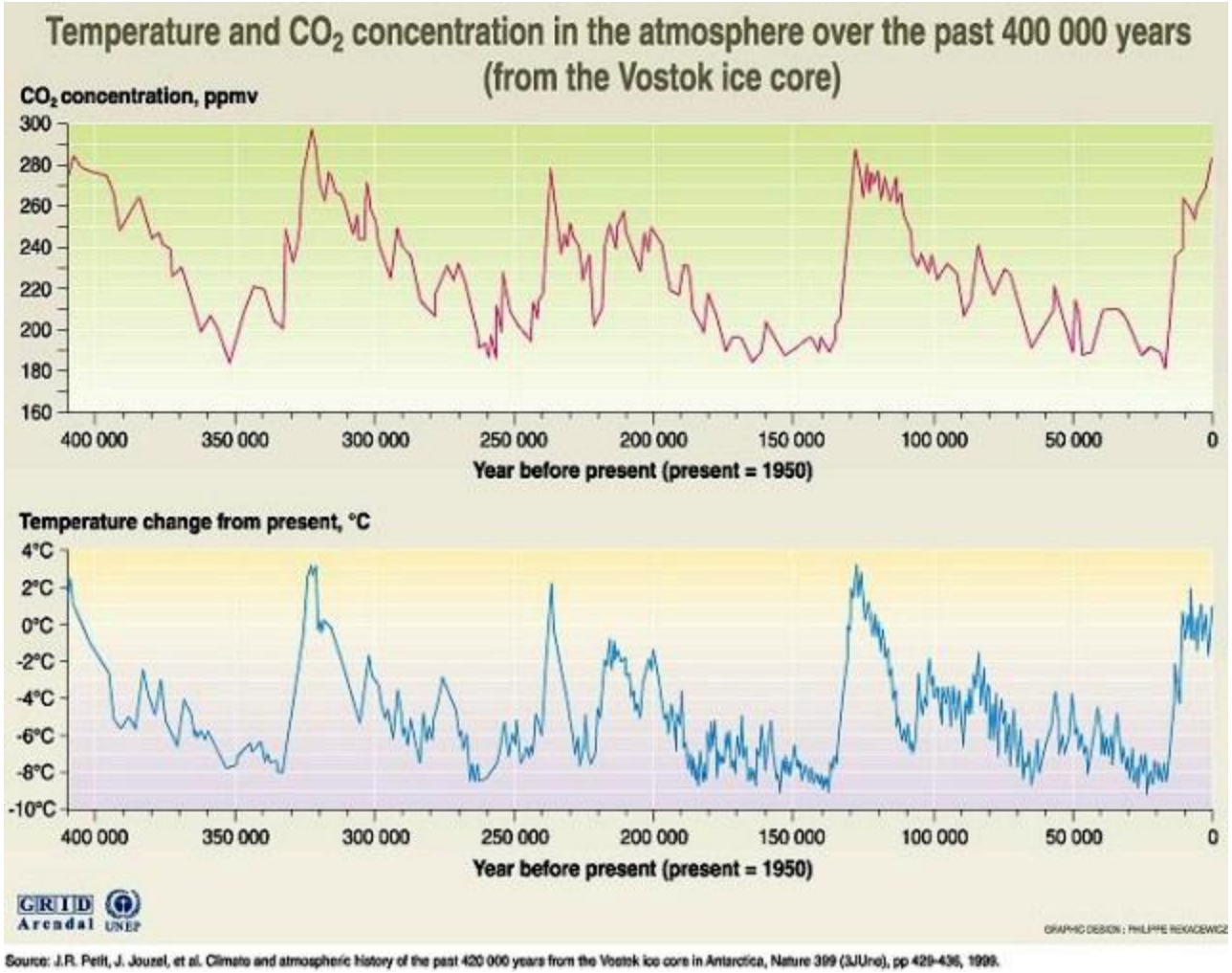
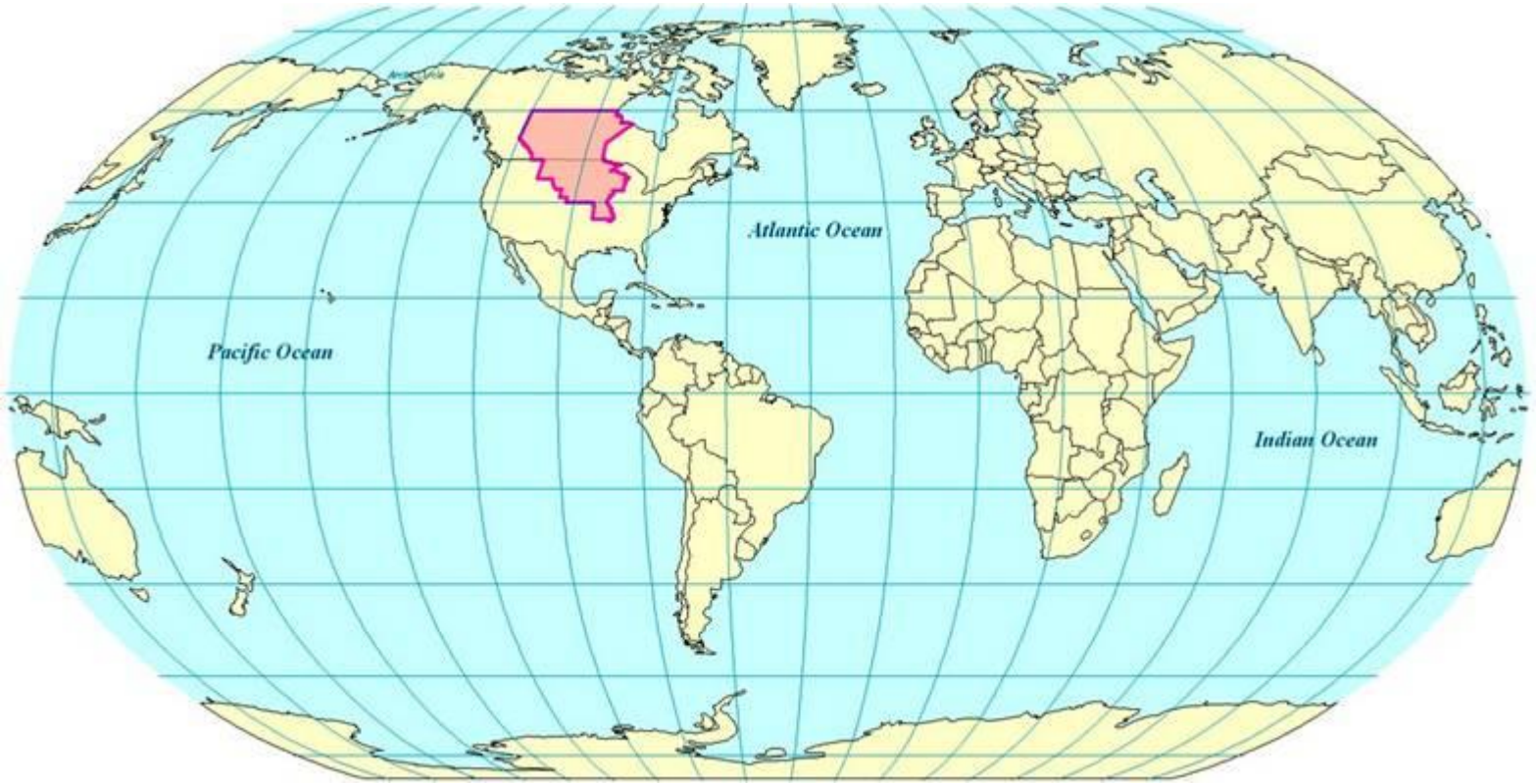
Atmospheric CO_2 Concentrations – A Geologic Perspective



Source: Petit, J.R., and others, 1999. Climate and atmospheric history of the past 420,000 years from the Vostok ice core, Antarctica. Nature 399: 429-436.

“We are moving into a *carbon-managed* world, not a *carbon-constrained* world."
— *R. Patrick*



Rick Patrick, Vice President, Planning, Environment, and Regulatory Affairs, SaskPower, personal communication (2004).

How Does the PCOR Partnership Add Value?

The PCOR Partnership: Catalogs, Catalyzes, and Monetizes

- We provide regional databases that ***catalog*** sources and sinks and help to determine what infrastructure is needed.
- We ***catalyze*** projects by brokering meetings with appropriate industrial participants, financiers, and regulators.
- We use our demonstration and validation activities to provide the technical and economic foundation needed to ***monetize*** carbon credits.

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Units and Range of "Typical" Reservoir Conditions

Pressure

75–145 atm (bar)

1100–2500 psi

2540–4920 feet of water

$1.3x10^6$–$2.6x10^6$ slugs/sq. perches

45–87 scrupels/sq. barleycorns*

Temperature

30°–140°C

85°–285°F

User

Chemists
Engineers
Geologists
Biologists
Regulators

Volume
1 scf = 56 g CO_2
16.3 mscf = 1 ton CO2

Concentration
1000 scf/bbl = 43 wt% (CO_2/oil)

*(estimated based on British barleycorn)

Density
API gravity 1 = 1.076 g/mL
API gravity 100 = 0.6112 g/mL

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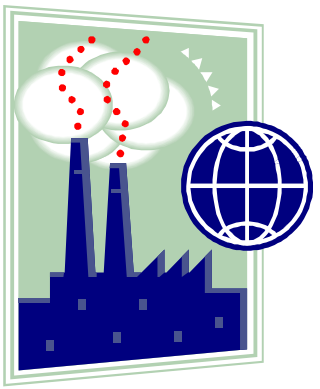
Technology Deployment Concerns

- Risks associated with CO_2 sequestration
  - Local environmental impacts (acute)
    - Environment
    - Human health and safety



  - Global atmospheric impacts (chronic)
    - Leaks that return stored CO_2 to the atmosphere

Technology Deployment Concerns

- Known facts to date concerning risks of CO_2 sequestration:

  - ☑ CO_2 can be safely stored in geological formations over long periods of time.
  - ☑ Environmental and ecological health effects are well understood.
  - ☑ The largest risks of CO_2 capture and storage have been identified.
  - ☑ CO_2 poses no health and safety risks at low concentrations.
  - ☑ CO_2 is not flammable or explosive but does react with water.

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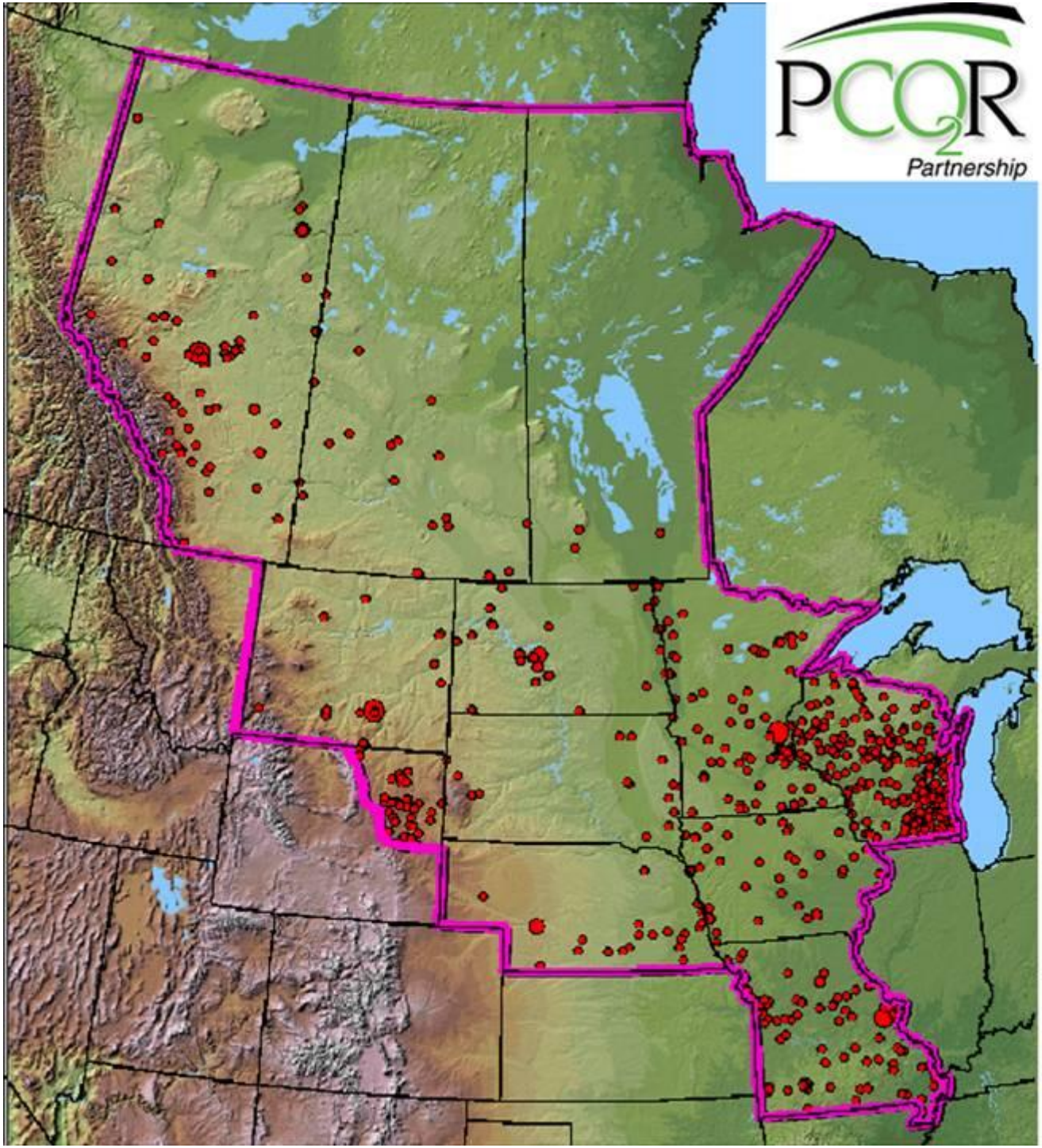

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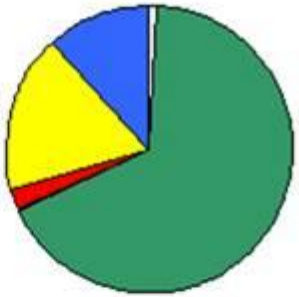
Sources

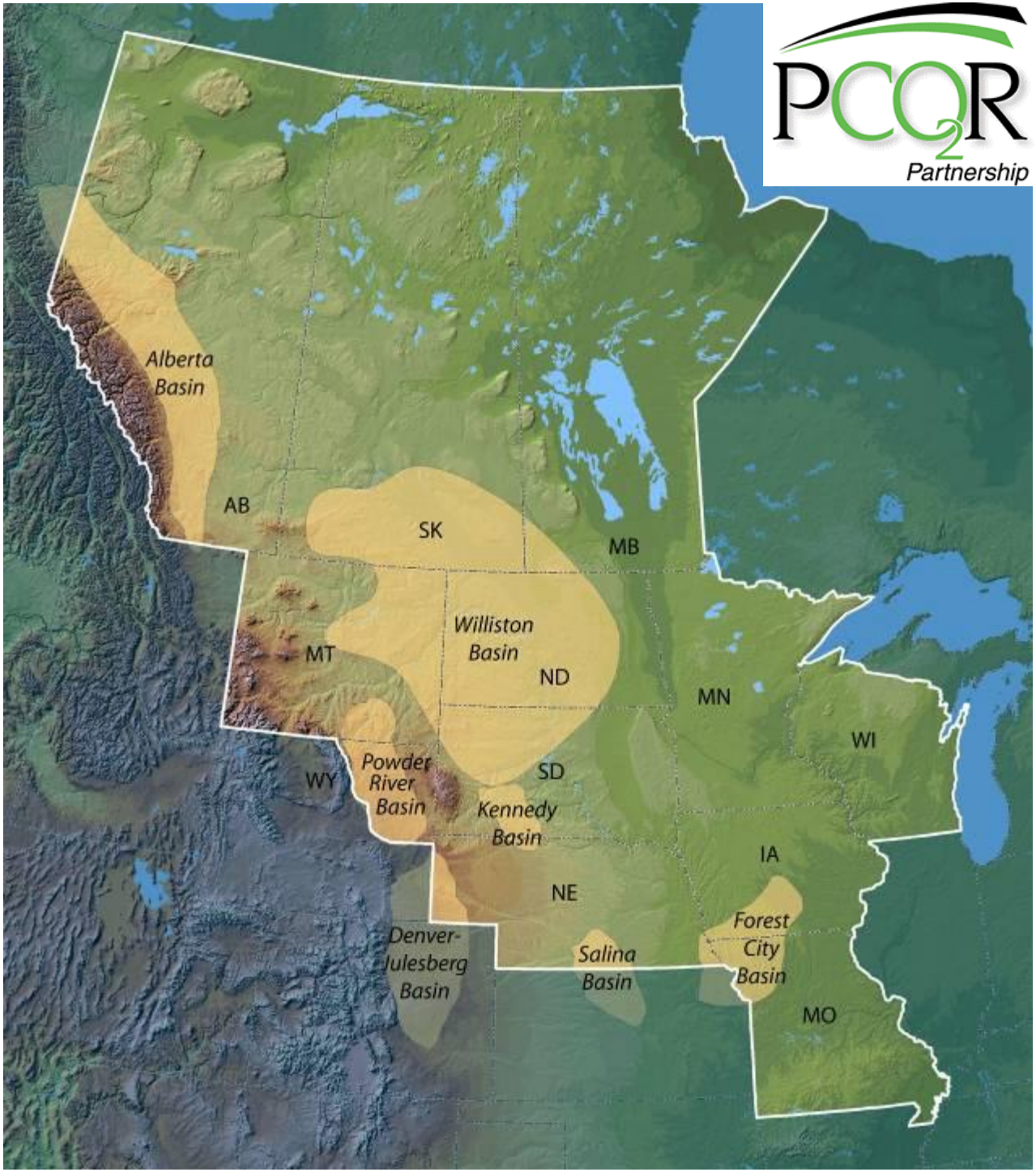
1367 stationary sources

Total CO_2 emissions:
619 million tons/yr

Emissions by Industry Category



- Ag Processing (1%)
- Electric Utility (67%)
- Ethanol (3%)
- Industrial 17%)
- Petroleum and Natural Gas (12%)



Sedimentary Basins

440,828 square miles

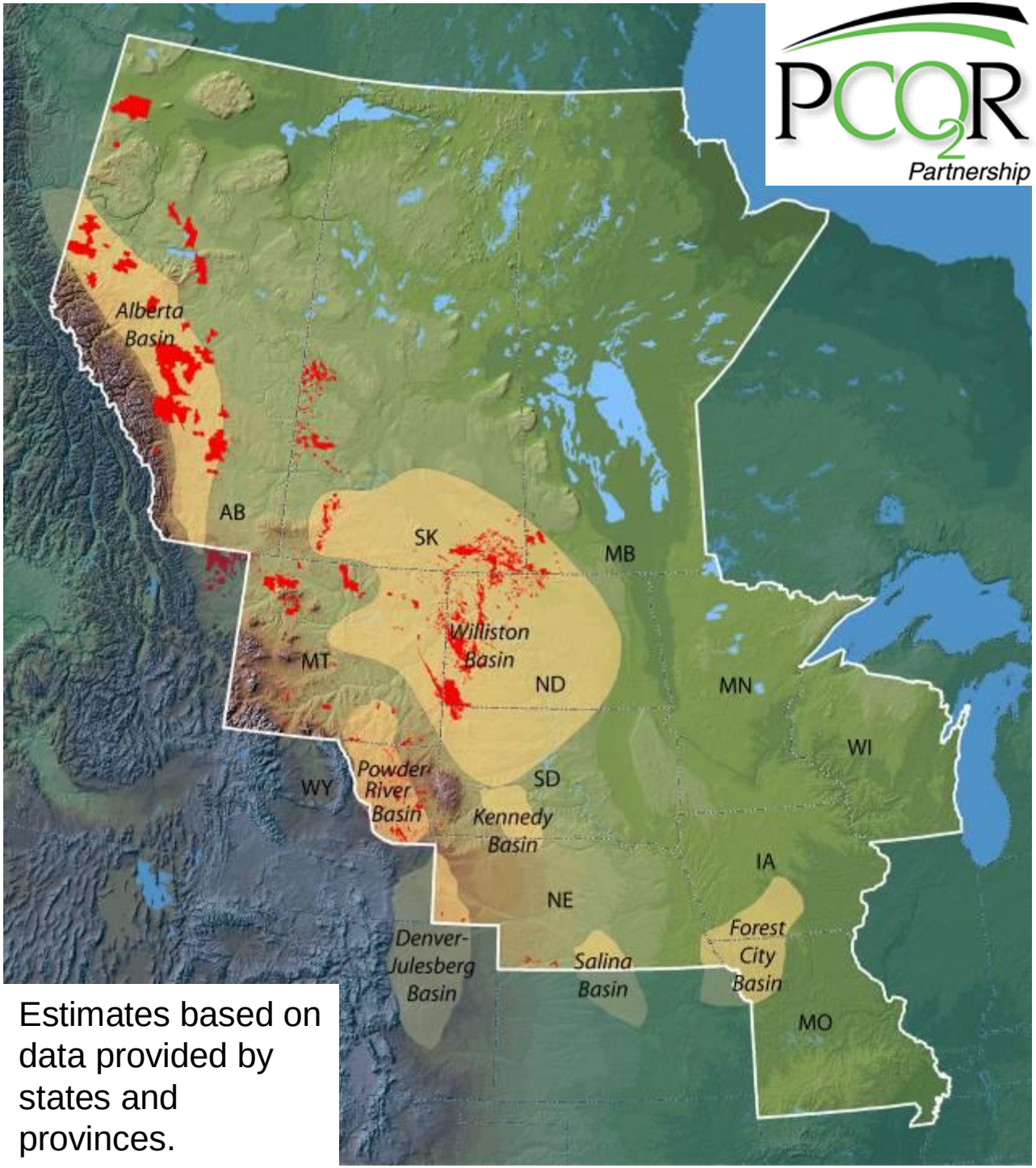
32% of region

Contain the primary, large-capacity sequestration targets.

Opportunities for value-added sequestration.

Stacked targets are common.

Include oil fields, coal seams and brine formations.



Estimates based on data provided by states and provinces.

Oil Fields

6000+ fields evaluated

Fields in the Williston, Powder River, Denver–Julesberg and Alberta Basins were evaluated

Used two methods: EOR and volumetric

- **Using EOR approach:**

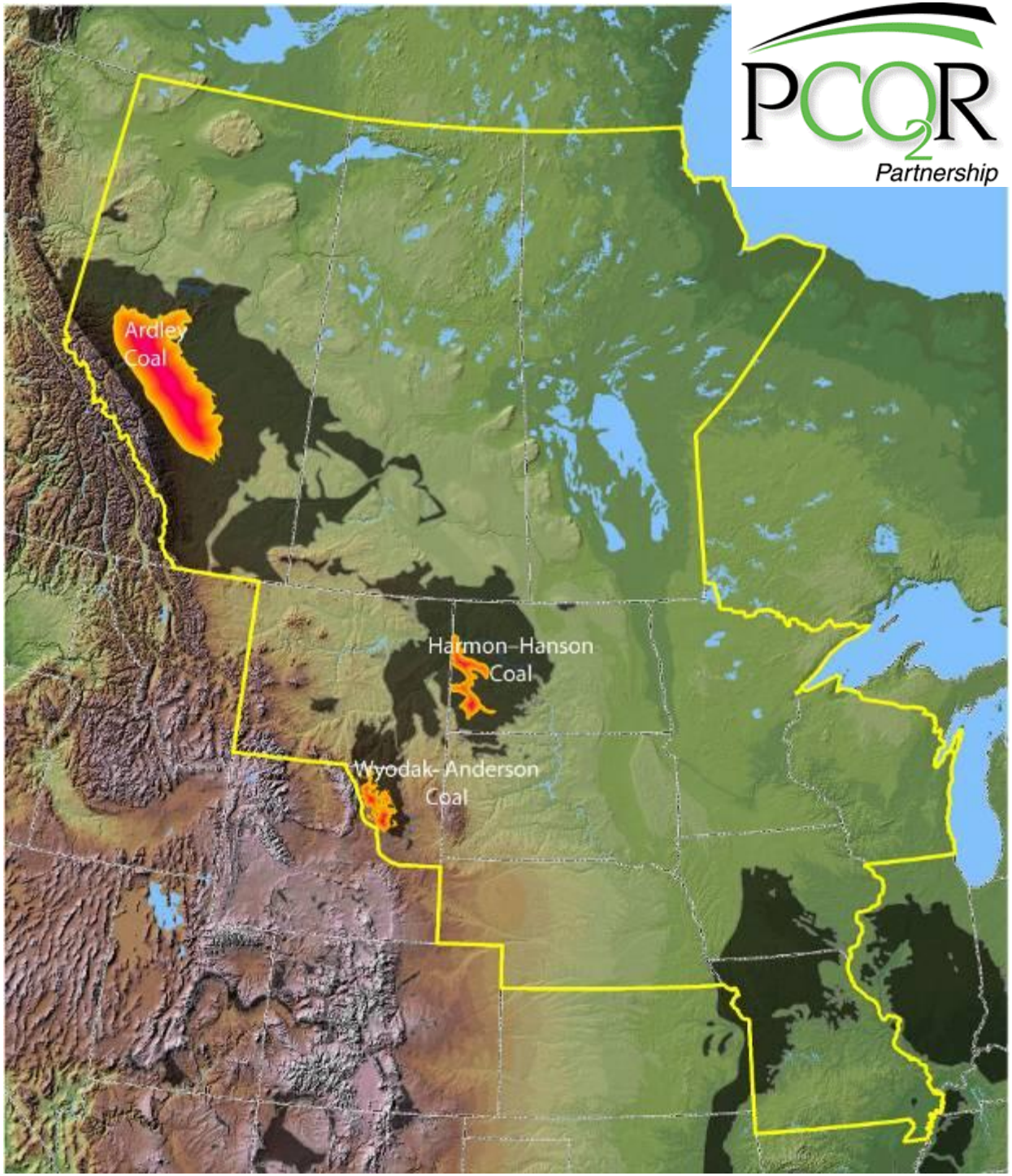
Evaluated ~ 160 fields.

Sequestration capacity = 1 billion tons

Incremental oil >3 billion bbls

- **Volumetric approach:**

Thousands of fields, total capacity >10 billion tons.



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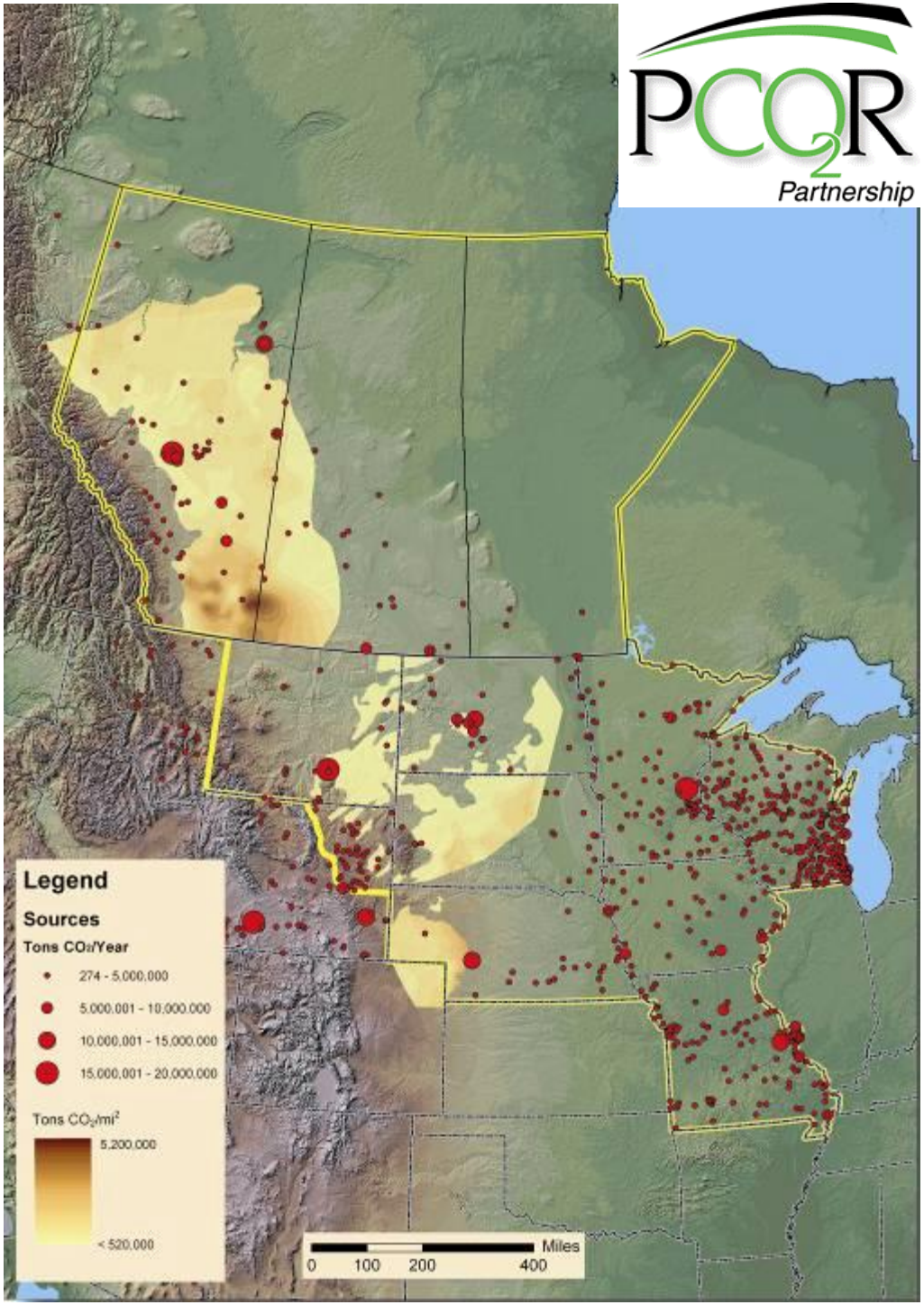
Coal Fields

Evaluated Wyodak–Anderson, Ardley, and Fort Union coals.

CO_2 sequestration capacity estimated to date: >8 billion tons

17 Tcf of methane potential from ECBM in these seams.

May be good near-term target for co-located coal-fired power plants.



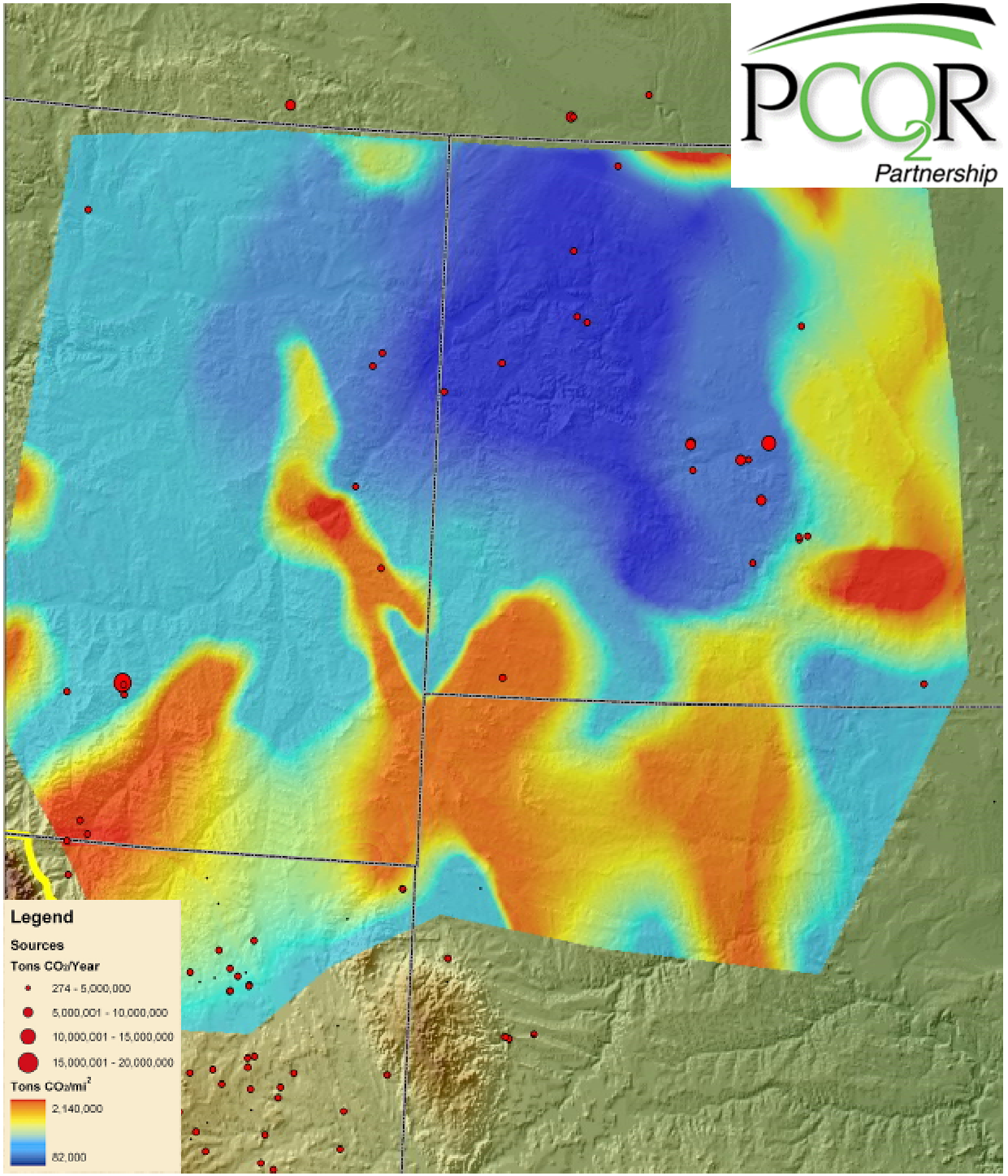
Lower Cretaceous Brine Formation Evaluation

Evaluated Lower Cretaceous system throughout the PCOR Partnership region.

CO_2 sequestration capacity estimated to date: >160 billion tons

Estimates based on porosity, permeability, and water chemistry data available in the literature and provided by partners.

Estimates represent an idealized potential capacity.



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Madison Brine Formation Evaluation

Evaluated Mississippian system in North Dakota, Montana, Wyoming, and South Dakota

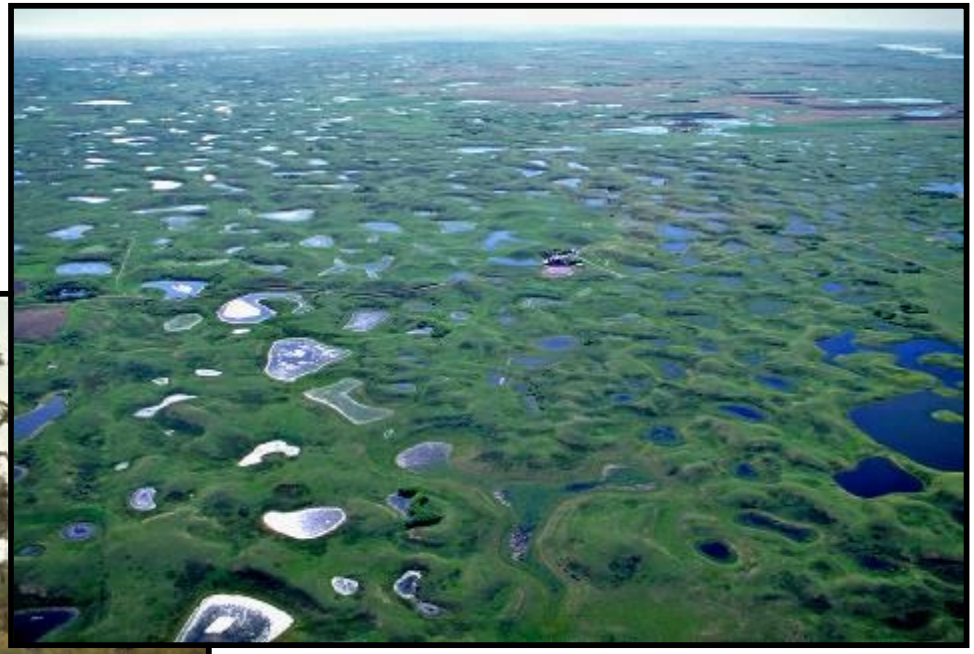
CO_2 sequestration capacity estimated to date: >60 billion tons

No value-added component to brine formation sequestration.

Co-located EOR and ECBM projects may provide necessary infrastructure.

Market for geologic sequestration credits is essential.

Prairie Pothole Region



Source: Ducks Unlimited

Source: www.personal.psu.edu/users/m/e/mes270/Pictures (accessed September 2005).

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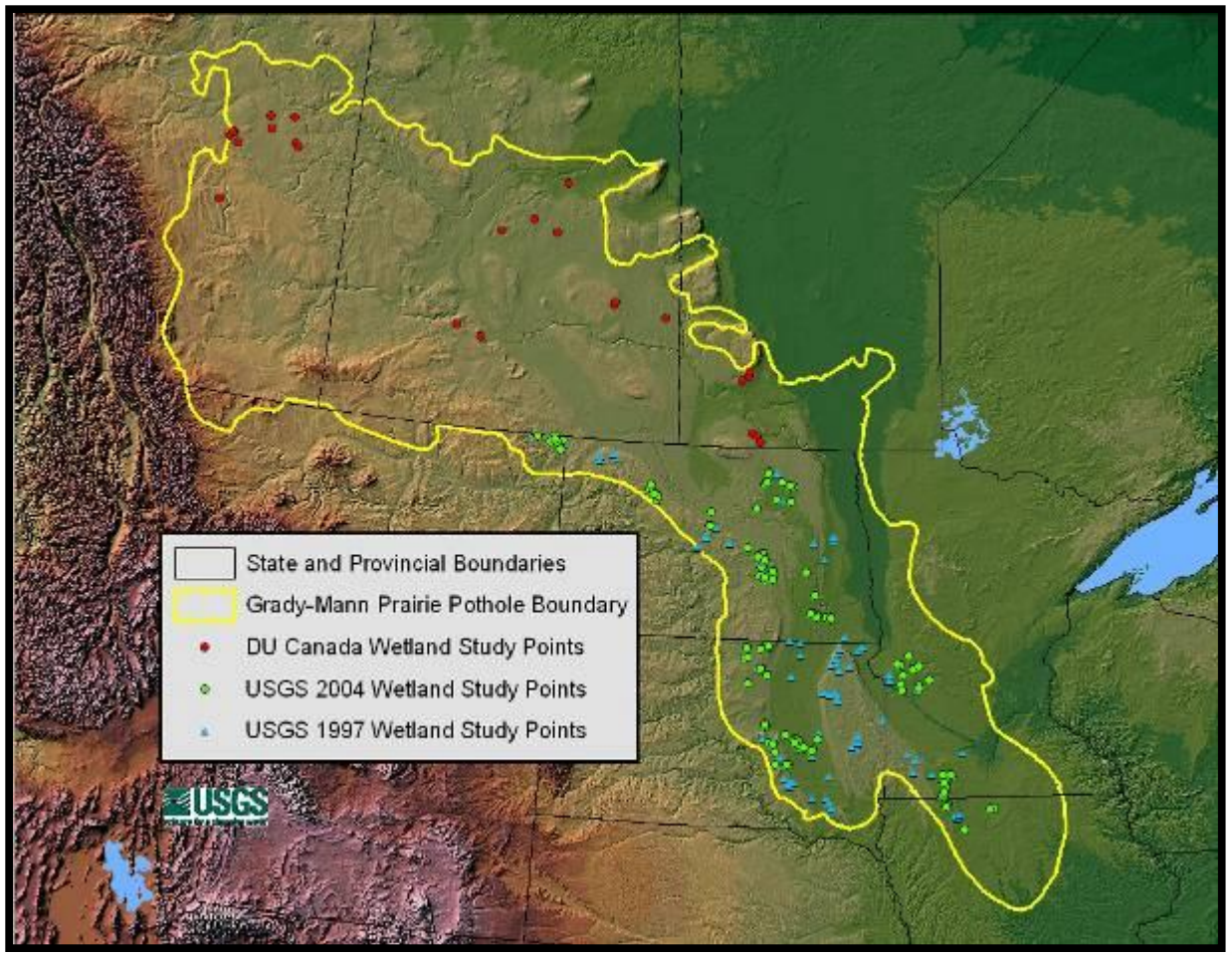
Terrestrial Field Validation Sites in the Prairie Pothole Region



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Field Validation Sites

Geologic Demonstrations

- G1 – Beaver Lodge, North Dakota. CO_2 injection site for CO_2 sequestration and EOR
- G2 – Zama, Alberta. Acid gas injection site for CO_2 sequestration and EOR
- G3 – Lignite coal in North Dakota. CO_2 injected into an unminable lignite coal seam for CO_2 sequestration and possible ECBM production

Terrestrial Demonstration

- T1 – Wetland sites monitored to establish sequestration potential and MMV technologies